ALTERNATIVE ASSESSMENT IN PROBLEM-BASED LEARNING: STRENGTHS, SHORTCOMINGS AND SUSTAINABILITY

By

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ABSTRACT

Problem-based learning (PBL) is a pedagogical method that challenges students to think intuitively and learn co-operatively in groups to seek solutions to real world problems. These problems are used as the building blocks to engage students' curiosity and initiate independent learning of subject matter. Authentic, alternative assessment plays a key role in the effective implementation of a PBL unit. The discussions in this paper are drawn upon the learning experiences of students enrolled in a tertiary institution that has developed its curriculum design based upon a rigorous PBL model. Based upon student feedback, some crucial issues focusing on the inherent strengths and pitfalls of authentic assessment techniques in the context of a PBL environment are explored. Students' comments on possible improvements to the assessment system are also analysed in this paper.

INTRODUCTION

Problem-based Learning

Problem-based learning (PBL) is an educational approach where problems, usually ill-structured ones stimulate the learning process. It stems from an instructional paradigm that is anchored in the precept of actively engaging students taking control of their own learning rather than sitting through a passive classroom environment where the teacher dominates much of learning interactions. The PBL approach started in the 1960s at McMaster Medical School as faculty developed PBL out of the perceived need to produce graduates who were prepared to deal with the complexities and dynamics of real world scenarios, and who could think critically and solve a range of problems. PBL attempts to structure the design of curriculum such that it involves confronting students with problems from practice which provide a stimulus for learning (Boud & Feletti, 1991). PBL is necessarily interdisciplinary. By addressing real-world problems, students have to cross the traditional disciplinary boundaries in their pursuit to solve the given problem. The academic rigours of such a pedagogical approach mandates the application of a repertoire of skills and domain knowledge expertise from a broad spread of different disciplinary fields. Participants develop specific skills in gathering, evaluating, and constructing knowledge representations as they first define the characteristics and boundaries of the multi-faceted problem space. Then through analytical reasoning and critical judgement, they put forward viable solutions to the given problem.

The instructor in a PBL class facilitates the learning process, by guiding the progress of the learners. Authoritative interference on the part of teachers in dictating learning directions and subordinating students' ability to, self-manage their learning expectations as typified in traditional classroom dynamics are conspicuously absent in PBL environments. In the PBL classroom, the faculty member is not the only resource for content or process information, but rather directs students to seek out appropriate resources. Gallagher & Stepien (1996) define the teacher's role as a facilitator or "metacognitive coach" during PBL. In short, the facilitator is a co-partner in the learning transactions. The distinguishing trait of PBL is that the instructional unit or activity is generally rooted to an authentic, non-bounded, ill-structured problem (i.e., information readily available to the students is not sufficient to solve the problem; a single, correct process

for solving the problem is not readily apparent or does not exist; the problem invites diverse, multilogical reasoning solution paths; the problem may change as the students attempt to solve it).

Assessment in problem-based learning

Assessment of student achievement is an important part of education. The alignment of instruction/teaching and assessment during PBL is critical for the success of a learning initiative. Both the instructional methods and assessment modes need to be framed by a common set of epistemological underpinnings. PBL being innovative and cognitively demanding, presents some unusual challenges for assessment. Traditional systems of assessment based upon norm-referencing fail to measure adequately the complexities of learner performance involved in newer, progressive forms of learning such as PBL. Since the focus of a PBL pedagogy is primarily on learning and less emphasis is placed on rote mastery of a particular body of knowledge, traditional methods of course assessment such as examinations may not be very effective (Major, 1999). A major weakness as highlighted by Resi and Renzulli (1991) of historical and contemporary PBL initiatives, is the lack of proper and formal evaluation of student achievement. More often than not assessment of student progress is haphazarad or non-existent. Indeed, when assessment is planned for, it often is not aligned well with the objectives of problem-based learning that preceeded it. Misalignments in PBL instruction-assessment modes could lower the effectiveness of the implementation of a PBL curricular approach (Nowak & Plucker, 1999). Traditionally instructional activities in a PBL environment are modelled based upon principles of constructivism and if the assessment model used to evaluate student learning doesn't similarly follow suit, the ensuing dissonance could potentially impede learner motivation and productivity. For instance presenting a complex, ill-structured problem anchored in real-world contexts to learners and guiding them to deconstruct and solve the problem, as the learning task for a PBL unit, but assessing student performance at the completion of the unit using a set of multiple choice questions or true/false questions is inconsistent and self-defeating.

Alternative assessment techniques that are more authentic and criterion-referenced are needed to measure learner achievement against defined learning objectives and outcomes using a set of explicit criteria. Examples of such alternative assessment methods include constructed response items, essays, writing samples, oral presentations, exhibitions, experiments, and/or portfolios (Ewing, 1998). Authentic assessment uses tasks developed from realistic activities in the professional world (Nightingale, Te Wiata, Toohey, Ryan, Hughes & Magin 1996). Nightingale, Te Wiata, et al., (1996) define authentic assessment tasks as "complex simulations, case studies, or multi-faceted projects . . . assessing a range of knowledge, skills and attitudes in the one assessment tasks". Allowing students to engage in these kinds of measures will allow the facilitators to assess intentional learning by examining and judging the students' actual or simulated performance on significant tasks (Worthen, 1993). Before an assessment method is planned, the principles of good assessment can help to guide practitioners. Instructors should begin by knowing what they want their students to achieve and how they want students to get there. They should consider that learning is a multidimensional activity; including knowledge and abilities as well as values, attitudes, and habits of the mind. In addition, when formulating learning goals, faculty members should think of learning in the larger context of the educational community. Assessment of, whether goals have been attained and learning has occurred, should have a clearly stated purpose, related to the learning. Thus, it should focus on comparing educational goals, and expectations with performance. Assessment should also be ongoing, throughout a semester, rather than occurring only at the end (American Association for Higher Education, 1992).

In the context of PBL, it is important to consider a variety of options for assessment to ensure that assessor bias is reduced significantly and high degrees of reliability and trustworthiness in evaluation outcomes is achieved. Some of these authentic assessment strategies include,

- ***Written examinations*** :Either as closed-book or open-

book examinations. Questions should be designed to ensure translation of skills to similar problems or subject domains.

- *Practical examinations:* where students need to be able to apply skills learned during the course.
- *Concept maps :* Requiring students to generate concept maps, in which they depict their knowledge through the creation of identified nodes and links, may present another option to determine their cognitive growth.
- *Peer assessment:* Providing peer students with an evaluation rubric often helps to guide the peer evaluation process. This process also stresses the cooperative nature of the PBL environment.
- *Self assessment :* This approach allows students to think more carefully about what they know, what they do not know, and what they need to know to accomplish certain tasks.
- *Facilitator/tutor assessment:* It is significant that facilitators do not dominate the group, but facilitate learning and exploration. Tutor assessment may consist of how successfully individuals interact with their group and their cognitive growth.
- *Oral Presentations:* This evaluation process could provide students an opportunity to work on their communication skills. Presenting findings to their group, the class, or even a real-life audience can help to strengthen these skills.
- *Reports:* Demanding written reports from students help them to practice this form of communication.

Some other authentic assessment formats include,

- *Outside Evaluation by Experts:* Since many PBL experiences involve a presentation, written projects, or portfolio, systematic evaluation of these projects by a team of outside experts can afford one means of evaluating student performance;
- *Content Analysis of Projects:* To assess the range of content knowledge learned by students in the class, instructors may need to evaluate across assignments and groups to look for the variety of resources students are collecting. Project analyses may also be useful in assessing skills such as researching critical analysis, or writing.
- *Focus Groups:* One method that can prove useful for assessing outcomes such as teamwork or leadership is the use of focus groups. Students can offer perspectives on their experience within the problem-solving group and may be able to reflect on their own growth across the experience.
- *Journals or Activity Logs:* Students in PBL classes often do the bulk of the work for a project outside the formal classroom. The work completed outside the classroom can be difficult to assess, so many instructors require students to keep a log or journal of the work they complete for the project. Mid-semester and/or end of semester evaluations of these journals or logs can provide excellent evidence of student learning throughout the project.
- *Personal Reflections:* One method for assisting students in their metacognitive understanding of the PBL process is to ask them to reflect on the experience of PBL at key points in the process. Qualitative analyses of these reflections can offer supportive evidence for many process-type outcomes such as developing critical thinking or research skills.

Description of sample and research site

This small scale study was conducted in a tertiary institution where the first author facilitates problem-based learning modules for first-year students. As an educational organization where premium is placed on innovative and stimulating instructional practices, this institution has developed its entire curriculum for all disciplinary fields based upon a problem-based learning model. A curriculum design based upon a problem-based learning model was adopted by policy makers in line with the overarching goal of the institution of empowering students to be reflexive, self-regulated and autonomous learners. The management of the institution viewed that embracing an instructional approach that harnesses the power of problem solving at all levels of academic study, though novel and revolutionary, would

be a strategic move in the right direction in preparing its students for this knowledge era. Some of the educational benefits of adopting such a paradigm shift in pedagogy involve provoking students to think divergently, engaging them in dialectical understandings and fostering argumentation skills in them through persuasive reasoning. Furthermore, a problem-based approach engenders in students the ability to analyze and synthesize information, reflect critically, harmonize conflicting perspectives, participate in social discourses and make valued judgments.

At this institution, concerted efforts have been made to avoid the potential shortcoming of a schism between instructional and assessment techniques that could undermine creativity and innovation in learning. Thus management of the institution has adopted a more holistic and highly integrated assessment system encompassing various evaluation components in consonance with the established goals and processes of PBL. Students' learning performances are comprehensively evaluated through multiple assessment mechanisms before students being awarded their overall daily grades. One assessment device is the rubrics-based evaluation of students' verbal team presentations and attendant artifacts constructed in justification of their proposed solutions to the given problem. Other components of the assessment system include quizzes to test students' conceptual understandings as well as peer and self assessments to measure students' contributions to the learning endeavour. Finally, students' entries in their online reflection journal in response to the posed question prompts are also evaluated. The question prompt in the reflection journals is meant to serve as the strategic scaffold and cognitive trigger that assists students to ponder over the many learning issues for the day's problem. The reflection journals are hosted in the institution's e-learning platform.

The sample of students in this study came from a class of 25 students for a first year common module. Classes for this module are held once a week and every class is normally broken up into random groups of five students each to collaboratively tackle the problem for the day. The students in the class ranged in ages from 17 to 19 and they were an even mix in terms of gender distribution. Though coming from different schools of disciplinary specialization such as applied sciences, engineering and information and communications technology, this module is a common subject for all first year students. As part of the research design for this study, the following question prompt was posed by in the reflection journals at the end of one of the day's problem:

"What are your views of the assessment system in its current form? Do you think it is being applied in a fair and consistent manner? How do you think it could further be improved?"

Thereafter students' electronic postings in their reflection journals to this prompt were collated for analysis.

Methodology of Data Analysis

Students' responses and expression of thoughts in the reflection journals were the prime source of data that were qualitatively examined through content analysis. Employing an approach of descriptive analysis allowed facilitators as the researchers to gain an useful insight into students' views of the assessment processes embedded in problem-based learning. A cursory examination of the reflection journal inputs was first done to trace out broad thematic categories according to the different strands of ideas articulated by students on their perceptions of the assessment system in place. Codes for these categories and constituent strands were next created in Atlas-ti, a software for qualitative data analysis. The textual data contained in the reflection journals was analytically parsed through and tagged with the appropriate labels for these codes. As and when necessary, codes were added in on the fly when new categories or strands were identified. The body of textual data was eventually filtered and reorganized according to the defined thematic categories and encompassing strands.

We have presented these findings and corollary discussions in the following sections based upon the three broad categories of strengths, weaknesses of and possible improvements to the existing model of assessment currently being implemented in the institution

involved in this study. For the purpose of ease of reading, we have taken the liberty to paraphrase appropriately students' comments on the issues under discussion. A few sample direct quotations taken from students' reflections have also been included to convey a better and more authentic understanding of the ideas generated by students. It is to be noted that these quotations have been corrected for errors in spelling, grammar and sentence structures.

Findings and discussions

Twelve students favourably reported on the comprehensiveness and expansiveness of the structure of the assessment system. They generally felt that the components of the system provided effective mechanisms for adequately measuring the various dimensions of the learning processes involved in PBL. They positively commented on both the formative and summative aspects of evaluation in-built in the system to gauge students' learning achievement for the day. The formative component of assessment involved facilitators closely supervising and observing throughout the day students' active participation in collaboratively engaging in deconstructing the problem through negotiating shared meanings and interpretations, tapping prior knowledge and analyzing information needs. Those students who were not constructively putting in sufficient efforts at participating in the co-operative problem-solving activities were identified and appropriately graded. The summative component of assessment presented opportunities for students to develop cognitive abilities and practice their social interactional skills within their group formations by reconciling conflicting perspectives and forging consensus in coming up with a collectively acceptable solution. Students' public oral communication skills were also strengthened in the process since they had to take up the responsibility of individually presenting their team's aggregate solution for the problem. Students found completing the quiz consisting of a combination of multiple choice questions and/or open-ended structured questions to be a good practice for reinforcement and review in understanding the key concepts and ideas covered in the PBL unit. The quiz was also viewed as an effective evaluation tool that enabled the facilitator to monitor and track students' learning trajectory over the duration of the entire module. Six students highlighted the utility of peer and self-evalutions as competent assessment instruments that allowed students' to reflect upon their learning practices. The items in the peer and self evaluation rubrics were useful criteria in emphasizing the largely social collaborative character of PBL for students. Students' reflection journal entries were considered by a number of students as a valuable source of evidence to measure their ability to engage in critical analysis and discussion of the learning issues raised by the question prompt.

A sample of students' general feedback on the strengths of the current assessment modes are attached as follows:

"The system is fair to a certain extent as students grades are based upon team presentation, self and peer evaluation, quiz score and RJ entries. For example, good interpersonal and group skills are required as one need to be evaluated by other team members. Active participation in discussions and listening actively to each member of the group is one of the strategies that could be used. Therefore there is a need for one to show commitment to self/student-directed learning and being able to do a good team presentation."

"I personally think that there is fairness in this system of assessment. For the fairness, it is basically on team presentation, quiz score and RJ entries. Why is this so? Below are some of the reasons. Firstly on the team presentation, it is to tell the facilitator how much of work you contributed. The facilitator can see through it in various ways like asking questions during presentations. They want to make sure that everyone contributes something within the group. In addition, the facilitator wants everyone to understand the day's problem and know what we are doing. Secondly on the quiz score and the RJ entries, it is basically to tell the facilitator how much we understand on the day's problem. If we did not really understand the problem well or did not listen attentively in the class, we definitely will not score well in the quiz and have no idea on doing well in the reflection journal."

"I think that it is fair because the grading is assessing how I performed for the day. Thus it is fair for those who have done their work with enthusiasm and had produced good work. This assessment helps to develop skills in self-assessment. Self-assessment is a skill essential to effective independent learning. So we can relate it to our learning and understand each lesson and aim of the module well. The assessments effectively use an integrated, flexible and usable knowledge base, and thus the facilitator is able to conclude what each individual has done in class and contributed to the team."

"This system of assessment is fair. We realise that we alone cannot function and need to work with people like a network. So I do agree with the peer and self evaluations because they serve as guidelines to how much you have contributed and how other people perceive your work attitude for that day. Quiz score is a good gauge on how much you have paid attention on that day."

A total of 14 students highlighted the inherent weaknesses they perceived from their daily interactions with the PBL assessment system. The large number of students discussing these shortcomings is hardly surprising considering the fact that the institution under study had been the first of its kind to have vigorously implemented PBL at all levels of academic training. Thus the curricular model in place is one that is constantly evolving with the higher management spiritedly refining and streamlining the elemental pedagogical processes in efforts aimed at improving learner motivation and stimulating higher order thinking. Thus a few nagging, contentious issues continue to plague the assessment system and which need to be addressed. Almost all the 14 responses received were unanimously emphatic in pointing out the imperfection of the assessment format in that it allowed some students to be 'free-riders' or those who fail to actively participate in group meetings or contribution of constructive ideas but are awarded better grades by non-discerning facilitators due to their better and often outspoken communication abilities. Thus the facilitators mistakenly evaluate these lackadaisical students as having played a key role in contributing towards the teams' efforts at co-framing viable solutions to the given problem. One student aptly describes this predicament as following: *Facilitators* gued that the peer and self evaluations had a considerable degree of bias as assessment tools since many students tend to be dishonest and not objective in appraising both their own and their teammates' performance for the day. This potentially clouds facilitators' ability to accurately gauge students' levels of productive learning engagement. Personal grudges and self-centered motives could also lower the reliability of peer and self evaluations. Yet another student cautioned that a few unprincipled students tend to plagiarise others' reflection journal entries and submit them as their own work. Thus facilitators need to be vigilant in pinpointing these students and assigning them in appropriate grades.

Some typical responses by students on the defects of the assessment model as they experienced them in the course of learning are included as follows:

"Now for the unfairness, it is most probably the self and peer evaluations. I believe that not many people are honest towards evaluation. Some of them do it quickly without thinking as they want to go home early while others feel that since we are friends and classmates, we need to help one another no matter whether it is true or not."

"We have seen how teams have had to put up with members who did not do anything, leaving either 1 or 2 to work out the problem on their own. These people in the end will eventually get credits since they are able to talk their way out during presentations."

"I personally think that there is a bit of injustice in the system of assessment. This is so because from my own experience, some pupils who do not fully play their part and responsibilities were given credits for their daily grade and worse still these pupils got better grades than those who deserve them. Referring to the team presentation itself is not enough , based upon my experience since there are a number of my classmates who do not even participate in the team discussions. Neither do they contribute voluntarily nor do they try to co operate with us. It is only during the presentatation time, that these people will tend to speak more especially

when they are better speakers of the team, leaving an impression to the facilitator that they have done their job well when actually they didn't. Furthermore knowing my classmates for almost one year, I personally believe that they don't really have the heart nor dare to evaluate their team members poorly. Self evaluation? Doesn't contribute much either. Quiz score - students can have access to some of the answers by discussing with others."

" I feel that using quiz score as one of the performance criteria is not fair. This is because not all students are able to understand and digest what has been taught in class or during the day. Not every student is a fast learner and some students need to go back home to revise what is taught in order to fully understand the objectives of the lesson. If some facilitators give quiz scores more importance, and if the student did not do well in the quiz his/her grade will be downgraded even though in other areas he/she has done well."

Sixteen of the students who participated in this study came up with creative suggestions to modify and refine existing assessment mechanisms as well as proposing new assessment tools/techniques. Many of these suggestions demonstrated students' abilities to think both analytically and innovatively. These suggestions also reflected students' concerns for the evaluation process to be improved so as to ensure that it remains as objective and unbiased as possible. Five students mentioned that the current practice of self- and peer evaluations involving limited, singular choices in indicating levels of participation for each of the criterion items as being simplistic and abstract. Two students recommended that an additional open-ended text box be appended to the online self and peer evaluation tools for students to be able to express in writing and defend with valid reasoning their peer and self assessment outcomes. One ingenious student argued that installing hidden cameras to closely monitor students' true levels of learning performance, though a good evaluation technique inevitably infringes on students' rights to privacy. Thus he suggested appointing on a rotational basis a student leader for each at the onset of the module in clearly explaining to students the weightage they would apportion to the components of the evaluation system. This will help the students to identify and focus on the vital aspects of assessment that have a greater bearing on the daily grades to be assigned. Many of the students remarked that currently the order of emphasis being placed on the various components in awarding the daily, cumulative grades varies between the facilitators and is being done in a rather subjective and ad-hoc manner. Attached are some sample comments by students in this area of possible improvements:

"To improve, I think that the facilitator must explain the amount of percentage for each particular type of evaluation. Or maybe prioritize the components. In my opinion, I think that we can give the team presentation less priority because we might be able to get other people's presentations and present them easily as our own. Every facilitator has a different way of managing and categorizing assessment. So, I think that this judging can be improved in many manners, as long as it is made known."

"I think that assessment of performance is fair if the facilitator actually assesses all parts like team presentation and so on. The facilitators should not only concentrate on one part of the assessment criteria. This is unfair to students who have done well for the other parts of the daily assessment."

"I think that it's only fair to grade students based on their quiz scores if the facilitator takes the average score among the whole class and then grades individually. Some students may just score due to pure luck and not because they understood the question. Therefore, it is only fair to take the average score among the class and then do the grading."

"This system can be improved by including a comment box where we could comment in writing on each team member, rather than the current choices which are limited to neutral, agree, strongly agree etc. That way the facilitator could somehow grasp the actual situation we're in when they're not in the class. Probably we could also have more RJ questions that reflect upon students' learning with regards to the day's problem and not

enquiring on some disembodied, general information. It is not fair for the students to talk about what they haven't really learnt and instead they end up copying and pasting information from resources to answer the question. The question should instead focus more on the task at hand."

Conclusion

Emergent evidence from this study indicate that alternative assessment modes such as evaluation of presentations by groups of students of their collective solutions to problems, peer and self assessments and appraisal of students' reflective journal entries are authentic methods in gauging students' performance in a problem-based learning environment. These assessment strategies enhance both the quality and standard of educational practices due to the proper fit of instruction/learning to assessment. Students felt that the assessment structure was rigorous, comprehensive and effective enough in competently evaluating their learning achievements.

A few of the students highlighted the fundamental shortcomings of the assessment format as is being currently implemented in their institution. Many a times there was a mismatch between the performance of the students and the daily grades the students were assigned due to the element of subjectivity embedded in alternative forms of assessment. Another significant concern was the high degree of bias inherent in peer and self assessments. Though the social nature of learning that is associated with PBL encouraged collaboration and teamwork, some unscrupulous students took advantage of this facility to plagiarize fellow students' work in their reflection journal submissions and passed them off as their own.

In continuing efforts at adapting the PBL system for its optimal operational performance and in line with evolving learning needs as a tertiary institution, students proffered useful suggestions to improve the assessment structure. Some of these suggestions included appointing group student leaders, modifying the response options for the items in the peer and self evaluation tools to be more open-ended and clarification by facilitators of the order of priority they accorded to the components of the assessment system in awarding daily grades.

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